

**APPENDIX A:
INORGANIC DATA
VALIDATION
PACKAGE/EMSL
ANALYTICAL, INC.
DATA**



EMSL Analytical, Inc.

200 Route 130 North, Cinnaminson, NJ 08077

Phone: (800) 220-3675 Fax: (856) 786-5974 Email: westmontaslab@EMSL.com

Attn: **Barbara Brocks**
Maryland Department of the Environment
1800 Washington Blvd.
Suite 625
Baltimore, MD 21230

Customer ID: MDEN50
Customer PO:
Received: 03/09/11 10:05 AM
EMSL Order: 041105173

Fax: (410) 537-3472 Phone: (410) 537-3493
Project: **BALD FRIAR QUARRY / SPRINGFIELD MINE**
NATURALLY OCCURING ASBESTOS (NOA) SITES

EMSL Proj:
Analysis Date: 3/22/2011

Test Report: PLM Analysis of Bulk Samples for Asbestos via EPA 600/R-93/116 Method with CARB 435 Prep (Milling) Level A for 0.25% Target Analytical Sensitivity

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
S-8-SPM-ASBESTOS 041105173-0008	- SOIL	Tan Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-9-SPM-ASBESTOS 041105173-0009	- SOIL	Tan Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-10-SPM-ASBESTOS 041105173-0010	- SOIL	Tan Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-11-SPM-ASBESTOS 041105173-0011	- SOIL	Brown Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-12-SPM-ASBESTOS 041105173-0012	- SOIL	Brown Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-13-SPM-ASBESTOS 041105173-0013	- SOIL	Tan Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected

Initial report from 03/23/2011 11:50:43

Analyst(s)

Peter Harrison (13)

Stephen Siegel, CIH, Laboratory Manager
or other approved signatory

This report relates only to the samples listed above and may not be reproduced except in full, without EMSL's written approval. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. EMSL is not responsible for sample collection activities or method limitations. Some samples may contain asbestos fibers below the resolution limit of PLM. EMSL recommends that samples reported as none detected or less than the limit of detection undergo additional analysis via TEM. Samples received in good condition unless otherwise noted.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ



EMSL Analytical, Inc.
 200 Route 130 North, Cinnaminson, NJ 08077

Phone: (800) 220-3675 Fax: (856) 786-5974 Email: westmontasbiab@EMSL.com

Attn: **Barbara Brocks**
Maryland Department of the Environment
1800 Washington Blvd.
Suite 625
Baltimore, MD 21230

Customer ID: MDEN50
 Customer PO:
 Received: 03/09/11 10:05 AM
 EMSL Order: 041105173

Fax: (410) 537-3472 Phone: (410) 537-3493
 Project: **BALD FRIAR QUARRY / SPRINGFIELD MINE**
NATURALLY OCCURING ASBESTOS (NOA) SITES

EMSL Proj:
 Analysis Date: 3/22/2011

Test Report: PLM Analysis of Bulk Samples for Asbestos via EPA 600/R-93/116 Method with CARB 435 Prep (Milling) Level A for 0.25% Target Analytical Sensitivity

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
S-1-SPM-ASBESTOS 041105173-0001	- SOIL	Brown Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-2-SPM-ASBESTOS 041105173-0002	- SOIL	Tan Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-3-SPM-ASBESTOS 041105173-0003	- SOIL	Brown Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-4-SPM-ASBESTOS 041105173-0004	- SOIL	Brown Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-5-SPM-ASBESTOS 041105173-0005	- SOIL	Tan Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-6-SPM-ASBESTOS 041105173-0006	- SOIL	Tan Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected
S-7-SPM-ASBESTOS 041105173-0007	- SOIL	Tan Non-Fibrous Homogeneous		100.00% Non-fibrous (other)	None Detected

Initial report from 03/23/2011 11:50:43

Analyst(s)

(b) (6) (13)

(b) (6)

(b) (6) CIH, Laboratory Manager
 or other approved signatory

This report relates only to the samples listed above and may not be reproduced except in full, without EMSL's written approval. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. EMSL is not responsible for sample collection activities or method limitations. Some samples may contain asbestos fibers below the resolution limit of PLM. EMSL recommends that samples reported as none detected or less than the limit of detection undergo additional analysis via TEM. Samples received in good condition unless otherwise noted.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
Environmental Sciences Center
701 Mapes Road
Fort Meade, Maryland 20755-5350

DATE : April 4, 2011
SUBJECT: Region III Data QA Review
FROM: Colleen Walling *CC Walling*
Region III ESAT RPO (3EA20)
TO: Lorie Baker
Remedial Project Manager (3HS12)

Attached is the inorganic data validation report for the Springfield Mine NOA site (Case #: 41039, SDG#: MC0310) completed by the Region III Environmental Services Assistance Team (ESAT) contractor under the direction of Region III EAID.

If you have any questions regarding this review, please call me at (410) 305-2763.

Attachment

cc: Phillip Anderson (MDE)

TO: #0037 TDF: #03111

OFFICE OF ANALYTICAL SERVICES AND QUALITY ASSURANCE

Lockheed Martin IS&GS – Civil
Energy & Environment
ESAT Region 3
US EPA Environmental Science Center
701 Mapes Road Ft. Meade, MD 20755-5350
Telephone 410-305-3037 Facsimile 410-305-3597



DATE: April 4, 2011

SUBJECT: Level IM1 Inorganic Data Validation for Case 41039
SDG: MC0310
Site: Springfield Mine Noa Site

FROM: Shilpa Udani 
Inorganic Data Reviewer

Through: Mahboobeh Mecanic 
Senior Data Review Chemist

TO: Colleen Walling
ESAT Region 3 Project Officer

OVERVIEW

Case 41039, Sample Delivery Group (SDG) MC0310, consisted of thirteen (13) soil samples submitted to Sentinel, Inc. (SENTIN) for total metals analysis. The sample set included two (2) field duplicate pairs. Samples were analyzed in accordance with Contract Laboratory Program (CLP) Statement of Work (SOW) ISM01.2 through the Routine Analytical Services (RAS) program.

SUMMARY

Validation of data was performed according to EPA Region 3 Innovative Approaches for Validation of Inorganic Data, Level IM1 and is assigned the Superfund Data Validation Label S3VM (Stage_3_Validation_Manual), which includes review of all Forms but excludes review of raw data. Areas of concern with respect to data usability are listed below.

Data in this case have been impacted by outliers present in laboratory blanks as well as matrix spike, laboratory duplicate and the ICP serial dilution analyses. Details for these outliers are discussed under "Major and Minor Problems" and qualified analytical results for all samples are summarized on the Data Summary Forms (DSFs).

MINOR PROBLEM

The matrix spike recovery was extremely low (< 30%) for antimony (Sb). Low recovery may be attributed to matrix interferences or analyte lost during the digestion process. Positive results reported for this analyte may be biased extremely low. The "L" qualifier for this outlier in affected samples has been superseded by "J" on the DSFs. Quantitation limits for this analyte in affected samples were rejected and qualified "R" on the DSFs.

MINOR PROBLEMS

The Preparation Blank (PB) had a reported result greater than the Method Detection Limit (MDL) for thallium (Tl). Positive results reported for this analyte in affected samples which are less than five times (<5X) the blank concentration may be biased high and have been qualified "B" on the DSF.

PB had a negative result greater than the absolute value of the Method Detection Limit (MDL) for beryllium (Be). Quantitation limits for this analyte in affected samples may be biased low and have been qualified "UL" on the DSFs.

Percent Differences (%Ds) for the ICP serial dilution analysis were outside the control limit (>10%) for calcium (Ca), cobalt (Co), lead (Pb), manganese (Mn) and potassium (K). Positive results for these analytes in all samples are estimated and have been qualified "J" on the DSFs.

Relative Percent Differences (RPDs) for the laboratory duplicate analysis were outside control limits (35% RPD or $\pm 2 \times \text{CRQL}$) for Ca and Mn. Reported results for these analytes in all samples are estimated and have been qualified "J" on the DSFs.

The matrix spike recovery was low (<75% but > 30%) for selenium (Se). No positive results were reported for this analyte. Quantitation limits for this analyte in all samples may be biased low and have been qualified "UL" on the DSFs.

NOTES

Positive results which are less than the Contract Required Quantitation Limits (CRQLs) but greater than MDLs have been qualified "J" on the DSFs unless superseded by "B".

The sample cooler containing samples MC0320, MC0321 and MC0322 had an interior temperature of 7.3 °C, which exceeded the required cooler temperature of 4 °C \pm 2 °C. Due to thermostability of metals, no data were qualified based on the sample cooler chest temperature.

The following samples were reanalyzed at dilution in order to bring the concentration of analytes listed below within the established calibration range. The results for these analytes in these samples are reported from the diluted analysis and annotated with a "+" on the DSFs.

<u>Sample</u>	<u>Dilution Factor</u>	<u>Affected Analytes</u>
MC0310	3.0 X	copper (Cu), iron (Fe), Mn, zinc (Zn)
MC0311, MC0321, MC0322	2.0 X	Fe
MC0312, MC0313	3.0 X	Mn
MC0314	10 X	Cu, Fe
MC0315	4.0 X	Fe, Mn
MC0316, MC0317	3.0 X	Cu, Fe
MC0318	5.0 X	Cu, Fe, Zn
MC0319	5.0 X	Cu, Fe
MC0320	20 X	Cu, Fe

Relative percent differences (RPDs) for the laboratory duplicate analysis were outside contractual control limits (20% RPD or \pm CRQL) for barium (Ba), chromium (Cr), and nickel (Ni). However, RPDs for these analytes were within Region 3 established control limits (35% RPD, or \pm 2XCRQL) for soil analysis. No data were qualified for these analytes based on laboratory duplicate imprecision.

The initial analysis of sample MC0310 had high Percent Relative Standard Deviation (%RSD) for Sb, Se and silver (Ag). The results for these analytes were reported from three fold (3.0X) dilution by the laboratory. CRQLs are elevated for these analytes in this sample.

Post-digestion Spike had a low recovery (<75% but > 30%) for Se. No data were qualified based on the post-digestion spike recovery.

Reported results for field duplicate pairs MC0312/MC0313 and MC0316/MC0317 were within 35%RPD, \pm 2XCRQL for all analytes except for Ca and Cr in duplicate pair samples MC0312/MC0313.

The %D for the serial dilution analysis was outside the control limit for Ca. Results for this analyte in all samples on Form Is and Form VIII were annotated by the reviewer to report this outlier.

ATTACHMENTS

INFORMATION REGARDING REPORT CONTENT

APPENDIX A	GLOSSARY OF DATA QUALIFIER CODES
APPENDIX B	DATA SUMMARY FORMS
APPENDIX C	CHAIN OF CUSTODY RECORDS
APPENDIX D	LABORATORY CASE NARRATIVE

DCN: 41039_MC0310.IM1

APPENDIX A

Glossary of Qualifier Codes

GLOSSARY OF DATA QUALIFIER CODES (INORGANIC)

CODES RELATED TO IDENTIFICATION

(confidence concerning presence or absence of analytes):

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

(NO CODE) = Confirmed identification.

B = Not detected substantially above the level reported in laboratory or field blanks.

R = Unusable result. Analyte may or may not be present in the sample. Supporting data necessary to confirm result.

N = Tentative identification. Consider present.
Special methods may be needed to confirm its presence or absence in future sampling efforts.

CODES RELATED TO QUANTITATION

(can be used for both positive results and sample quantitation limits):

J = Analyte Present. Reported value may not be accurate or precise.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

L = Analyte present. Reported value may be biased low.
Actual value is expected to be higher.

UJ = Not detected, quantitation limit may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

OTHER CODES

Q = No analytical result.

APPENDIX B
Data Summary Forms

DATA SUMMARY FORM: INORGANIC

Case #: 41039 SDG: MC0310

Number of Soil Samples: 13

Site: Springfield Mine Noa Site

Number of Water Samples: 0

Lab.: SENTIN

Sample Number:	MC0310	MC0311	MC0312	MC0313	MC0314						
Sampling Location:	S-1	S-10	S-11	S-12	S-13						
Field QC :			Dup. of MC0313	Dup. of MC0312							
Matrix:	Soil	Soil	Soil	Soil	Soil						
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						
Date Sampled:	3/8/2011	3/8/2011	3/8/2011	3/8/2011	3/8/2011						
Time Sampled:	11:05	11:55	12:00	12:05	12:10						
%Solid:	72.1	80.1	49.3	46.9	88.7						
Dilution Factor:	1.0/3.0	1.0/2.0	1.0/3.0	1.0/3.0	1.0/10						
ANALYTE	CRQL	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
ALUMINUM	20	17400		18300		9920		9500		13700	
ANTIMONY	6	+	R		R		R	0.14	J		R
*ARSENIC	1	4.9		3.1		3.2		2.9			
BARIUM	20	84.2		69.0		117		133		96.7	
BERYLLIUM	0.5	0.77		0.74		0.70	J	0.68	J		UL
*CADMIUM	0.5	0.35	J	0.14	J	0.43	J	0.44	J	0.23	J
CALCIUM	500	1390	J	6210	J	4860	J	18900	J	457	J
*CHROMIUM	1	120		38.4		45.7		29.1		96.8	
COBALT	5	94.3	J	17.5	J	22.5	J	19.6	J	148	J
COPPER	2.5	695 +		32.2		32.6		31.2		1200 +	
IRON	10	55300 +		24400 +		23600		18000		33500 +	
*LEAD	1	48.2	J	15.1	J	40.1	J	37.6	J	3.7	J
MAGNESIUM	500	3960		4340		2970		3080		12900	
MANGANESE	1.5	1380 +	J	504	J	1930 +	J	2380 +	J	207	J
MERCURY	0.1	0.12	J	0.024	J	0.12	J	0.12	J	0.77	
*NICKEL	4	57.0		23.7		21.2		19.3		68.1	
POTASSIUM	500	1110	J	2350	J	931	J	994	J	4440	J
SELENIUM	3.5	+	UL		UL		UL		UL		UL
SILVER	1	+		0.12	J	0.12	J	0.13	J	3.4	
SODIUM	500	135	J	143	J	210	J	228	J	131	J
THALLIUM	2.5										
VANADIUM	5	58.2		41.7		40.9		30.2		28.0	
ZINC	6	221 +		71.0		97.1		95.8		360	

CRQL = Contract Required Quantitation Limit

*Action Level Exists

SEE NARRATIVE FOR CODE DEFINITIONS

To calculate sample quantitation limits: (CRQL * Dilution Factor)

Revised 09/99

DATA SUMMARY FORM: INORGANIC

Case #: 41039 SDG: MC0310
 Site: Springfield Mine Noa Site
 Lab.: SENTIN

Sample Number:	MC0315	MC0316	MC0317	MC0318	MC0319						
Sampling Location:	S-2	S-3	S-4	S-5	S-6						
Field QC :		Dup. of MC0317	Dup. of MC0316								
Matrix:	Soil	Soil	Soil	Soil	Soil						
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						
Date Sampled:	3/8/2011	3/8/2011	3/8/2011	3/8/2011	3/8/2011						
Time Sampled:	11:15	11:18	11:20	11:35	11:40						
%Solid:	75.7	70.2	85.3	81.7	78.0						
Dilution Factor:	1.0/4.0	1.0/3.0	1.0/3.0	1.0/5.0	1.0/5.0						
ANALYTE	CRQL	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
ALUMINUM	20	21200		6220		6050		9310		8790	
ANTIMONY	6	0.80	J		R	0.17	J	0.34	J	0.47	J
*ARSENIC	1	3.1		0.64	J	0.39	J	1.7		1.9	
BARIUM	20	91.0		38.3		31.8		31.1		48.1	
BERYLLIUM	0.5	0.23	J	0.18	J	0.20	J		UL	0.16	J
*CADMIUM	0.5	0.32	J	0.30	J	0.28	J	0.39	J	0.27	J
CALCIUM	500	5290	J	2610	J	1520	J	206	J	330	J
*CHROMIUM	1	126		95.6		74.6		220		249	
COBALT	5	39.7	J	112	J	134	J	122	J	102	J
COPPER	2.5	58.6		669 +		771 +		1330 +		1500 +	
IRON	10	40300 +		60800 +		62300 +		103000 +		93200 +	
*LEAD	1	10.0	J	44.7	J	40.0	J	3.3	J	23.8	J
MAGNESIUM	500	10800		2340		2160		7870		7670	
MANGANESE	1.5	1640 +	J	511	J	545	J	304	J	467	J
MERCURY	0.1	0.049	J	0.077	J	0.071	J	0.23		0.14	
*NICKEL	4	74.8		75.0		66.8		100		111	
POTASSIUM	500	755	J	573	J	490	J	1090	J	1350	J
SELENIUM	3.5		UL		UL		UL		UL		UL
SILVER	1	0.58	J	0.87	J	0.96	J	2.1		2.3	
SODIUM	500	160	J	146	J	111	J	136	J	151	J
THALLIUM	2.5			0.38	B	0.16	B	0.54	B	0.56	B
VANADIUM	5	80.4		35.9		33.7		41.6		41.9	
ZINC	6	82.6		227		214		817 +		463	

CRQL = Contract Required Quantitation Limit

*Action Level Exists

SEE NARRATIVE FOR CODE DEFINITIONS

To calculate sample quantitation limits: (CRQL * Dilution Factor)

Revised 09/99

DATA SUMMARY FORM: INORGANIC

Case #: 41039 SDG: MC0310

Site: Springfield Mine Noa Site

Lab.: SENTIN

Sample Number:	MC0320	MC0321	MC0322								
Sampling Location:	S-7	S-8	S-9								
Field QC :											
Matrix:	Soil	Soil	Soil								
Units:	mg/kg	mg/kg	mg/kg								
Date Sampled:	3/8/2011	3/8/2011	3/8/2011								
Time Sampled:	11:45	11:25	12:20								
%Solid:	81.5	76.0	75.4								
Dilution Factor:	1.0/2.0	1.0/2.0	1.0/2.0								
ANALYTE	CRQL	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
ALUMINUM	20	8020		17500		22300					
ANTIMONY	6	0.36	J		R		R				
*ARSENIC	1	0.30	J	2.6		3.4					
BARIUM	20	30.6		66.4		72.1					
BERYLLIUM	0.5		UL	0.76		0.51	J				
*CADMIUM	0.5	1.1		0.15	J	0.13	J				
CALCIUM	500	208	J	2050	J	1120	J				
*CHROMIUM	1	116		37.6		34.3					
COBALT	5	130	J	21.0	J	12.1	J				
COPPER	2.5	4630 +		97.6		80.3					
IRON	10	55700 +		31900 +		36600 +					
*LEAD	1	6.6	J	9.8	J	8.8	J				
MAGNESIUM	500	7700		2950		1880					
MANGANESE	1.5	233	J	395	J	211	J				
MERCURY	0.1	0.16		0.042	J	0.053	J				
*NICKEL	4	57.5		18.8		16.0					
POTASSIUM	500	1120	J	2130	J	1380	J				
SELENIUM	3.5		UL		UL		UL				
SILVER	1	1.7				0.34	J				
SODIUM	500	137	J	148	J	148	J				
THALLIUM	2.5										
VANADIUM	5	28.3		46.8		49.5					
ZINC	8	1740 +		70.2		59.5					

CRQL = Contract Required Quantitation Limit

*Action Level Exists

SEE NARRATIVE FOR CODE DEFINITIONS

To calculate sample quantitation limits: (CRQL * Dilution Factor)

Revised 09/99

APPENDIX C

Chain of Custody (COC) Records



USEPA Contract Laboratory Program Inorganic Traffic Report & Chain of Custody Record

Case No: 41039

R

Project Code: CT5343 Account Code: 2011 T03W 302DD2C A3QL S100 RCLIS ID: MDN000306713 Client ID: AQL Project Name/State: SPRINGFIELD MINE NOA SITE/MD Project Leader: Phillip Anderson Location: Site Investigation Sampling Co.: MDE Federal Superfund Division		Date Shipped: 3/8/2011 Carrier Name: FedEx Airbill: 8729 2718 6310 Shipped to: Sentinel Inc. 4733 Commercial Drive Huntsville AL 35816 (256) 534-9800	
Chain of Custody Record			
Refiniquished By 1 2 3 4		Received By (Date / Time)	

ORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNOVER	PRESERVATIVE/ Bottles	TAG No./	STATION LOCATION	SAMPLE COLLECT DATE/TIME	ORGANIC SAMPLE No.	QC Type
M 310	Surface Soil (0"-12")/ Phillip Anderson	L/G	TM+HG (21)	3631 (Ice Only) (1)		S-1	3/8/2011 11:05		
M 311	Surface Soil (0"-12")/ Phillip Anderson	L/G	TM+HG (21)	3632 (Ice Only) (1)		S-10	3/8/2011 11:55		
M 312	Surface Soil (0"-12")/ Phillip Anderson	L/G	TM+HG (21)	3634 (Ice Only) (1)		S-11	3/8/2011 12:00		
M 313	Surface Soil (0"-12")/ Phillip Anderson	L/G	TM+HG (21)	3636 (Ice Only) (1)		S-12	3/8/2011 12:05		Field Duplicate
M 314	Surface Soil (0"-12")/ Phillip Anderson	L/G	TM+HG (21)	3638 (Ice Only) (1)		S-13	3/8/2011 12:10		
M 315	Surface Soil (0"-12")/ Phillip Anderson	L/G	TM+HG (21)	3644 (Ice Only), 3645 (Ice Only), 3646 (Ice Only) (3)		S-2	3/8/2011 11:15		MS/MSD
M 316	Surface Soil (0"-12")/ Phillip Anderson	L/G	TM+HG (21)	3648 (Ice Only) (1)		S-3	3/8/2011 11:18		

Shipment for Case: MC0315, MC0321	Sample(s) to be used for laboratory QC: MC0315, MC0321	Additional Sampler Signature(s): 	Chain of Custody Seal Number:
Analysis Key: TI - HG = CLP ICP-AES TM+HG	Concentration: L = Low, M = Low/Medium, H = High	Type/Designate: Composite = C, Grab = G	Shipment Lead?

TF Number: 3-092922069-030811-0002
 PR: Provides preliminary results. Requests for preliminary results will increase analytical costs.
 Ser: Copy to: Sample Management Office, 15000 Conference Center Dr., Chantilly, VA. 20151-3819 Phone 703/818-4200; Fax 703/818-4602

REGION COPY



USEPA Contract Laboratory Program Inorganic Traffic Report & Chain of Custody Record

Case No: 41039

R

Project: 3 Project Code: CT5343 Account Code: 2011 T03W 302DD2C A3QL S100 PROJECTS ID: MDN000306713 Site ID: AQL Site Name/State: SPRINGFIELD MINE NOA SITE/MD Project Leader: Phillip Anderson Location: Site Investigation Sampling Co: MDE Federal Superfund Division		Date Shipped: 3/8/2011 Carrier Name: FedEx Airbill: 8729 2718 6310 Shipped to: Sentinel Inc. 4733 Commercial Drive Huntsville AL 35816 (256) 534-9800	
Chain of Custody Record		Sampler Signature	
Relinquished By		Received By	
1			
2			
3			
4			

SAMPLE NO.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME	ORGANIC SAMPLE No.	QC Type
MC 317	Surface Soil (0*-12")/ Phillip Anderson	L/G	TM+HG (21)	3650 (Ice Only) (1)	S-4	3/8/2011 11:20		Field Duplicate
MC 318	Surface Soil (0*-12")/ Phillip Anderson	L/G	TM+HG (21)	3662 (Ice Only) (1)	S-5	3/8/2011 11:35		
MC 319	Surface Soil (0*-12")/ Phillip Anderson	L/G	TM+HG (21)	3654 (Ice Only) (1)	S-6	3/8/2011 11:40		
MC 320	Surface Soil (0*-12")/ Phillip Anderson	L/G	TM+HG (21)	3656 (Ice Only) (1)	S-7	3/8/2011 11:45		
MC 321	Surface Soil (0*-12")/ Phillip Anderson	L/G	TM+HG (21)	3658 (Ice Only), 3659 (Ice Only), 3660 (Ice Only) (3)	S-8	3/8/2011 11:25		MS/MSD
MC 322	Surface Soil (0*-12")/ Phillip Anderson	L/G	TM+HG (21)	3662 (Ice Only) (1)	S-9	3/8/2011 12:20		

Shipment for Case #: MC0315, MC0321	Sample(s) to be used for laboratory QC: MC0315, MC0321	Additional Sampler Signature(s): 	Chain of Custody Seal Number:
Analysis Key: L/G = CLP ICP-AES TM+HG	Concentration: L = Low, M = Low/Medium, H = High	Type/Designator: Composite = C, Grab = G	Shipment tested?

TR Number: 3-092922069-030811-0002

PR: Please refer to preliminary results. Requests for preliminary results will increase analytical costs.

Send copy to: Sample Management Office, 15000 Conference Center Dr., Chantilly, VA, 20151-3819 Phone 703/618-4200; Fax 703/618-4602

REGION COPY
F2V5.1.047 Page 2 of 2

U.S. EPA Region III Analytical Request Form

Revision 10.06

ASQAB USE ONLY	
RAS#	CT5343
DAS#	Analytical TAT
NSF#	21

41039

Date	February 1, 2011		Site Activity:	SI		
Site Name:	SPRINGFIELD MINE NOA SITE					
City	Sykesville	State:	MD	Street Address:	710 Obrecht Road <i>Carroll Co. Tax Map 7, Parcel 17</i>	
Program:	CERCLA	Acct. #:	2011 T 03W 302DD2C A3QL S100	Latitude:	039° 22' 54.27" north	
Site ID:	0306713	Spill ID:	A3QL	Longitude:	076° 58' 30.03" west	
Site Specific QA Plan Submitted:	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes		CERCLIS#:	MDN000306713		
EPA Project Leader: Lorie Baker			Operable Unit:	00		
Request Preparer: Barbara Brocks			Title: Preliminary Assessment/Site Inspection Sampling and Analysis Plan for the Springfield Mine NOA Site (MD-590)			
Site Leader: Phillip Anderson			Phone#:	215-814-3355	Cell Phone #:	215-370-7377
Contact: MDE-LRP-FSD			Phone#:	410-537-3497	Cell Phone #:	443-928-9074
EPA CO/PO:			Phone#:	410-537-3448	Cell Phone #:	
PARAMETER			METHOD			
13	Solids	TAL Metals + Hg	<i>Sentin</i>			
CLP SOW ISM01.2 ICP-AES			<i>33489</i>			
Ship Date From:	03/08/2011	Ship Date To:	03/09/2011	Org. Validation Level M2	Inorg. Validation Level IM1	
Unvalidated Data Requested:	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes	If Yes, TAT Needed:	<input type="checkbox"/> 14days <input type="checkbox"/> 7days <input type="checkbox"/> 48hrs <input type="checkbox"/> 24hrs	<input type="checkbox"/> Other (Specify)		
Validated Data Package Due:	<input checked="" type="checkbox"/> 42 days <input type="checkbox"/> 30 days <input type="checkbox"/> 21days <input type="checkbox"/> 14 days	<input type="checkbox"/> Other (Specify) CLP <i>21/21</i>				
Electronic Data Deliverables Required: <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes (EDDs will be provided in Region 3 EDD Format)						
Special Instructions:						

USEPA - CLP

COVER PAGE

Lab Name: Sentinel

Contract: EPW09040

Lab Code: SENTIN Case No.: 41039

Mod. Ref. No.

SDG No.: MC0310

SOW No.: ISM01.2

EPA SAMPLE NO.	Lab Sample ID.
MC0310	12375
MC0311	12376
MC0312	12377
MC0313	12378
MC0314	12379
MC0315	12380
MC0315D	12380S2
MC0315S	12380MS
MC0316	12381
MC0317	12382
MC0318	12383
MC0319	12384
MC0320	12385
MC0321	12386
MC0322	12387

ICP-AES ICP-MS

Were ICP-AES and ICP-MS interelement corrections applied? (Yes/No) YES

Were ICP-AES and ICP-MS background corrections applied? (Yes/No) YES

If yes-were raw data generated before application of background corrections? (Yes/No) YES

The laboratory did not receive any instructions with this SDG to modify the SOW standard laboratory sample preparation procedures (e.g., subsampling). To aid in the determination of data usability with respect to project decisions, any modifications performed are described below.

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy Sample Data Package and in the electronic data submitted has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: [Signature] Name: Paul L. Gause
Date: 3/21/11 Title: QA

U.S. EPA - CLP

SDG NARRATIVE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: Sentinel, Inc. SOW No.: ISM01.2 Contract: EPW09040
Lab Code: SENTIN Case No.: 41039 NRAS No.: SDG No.: MC0310

SAMPLE RECEIPT: Temperature Blank: PRESENT ABSENT

If a blank is absent, a non-invasive laser measurement it taken using a sample.

Cooler temperature(s) recorded via laser measurement were: 2.3°C

Refer to Record of Communication (ROC) regarding EPA Sample # discrepancies for samples:

None

Refer to ROC regarding tag discrepancies for samples:

None

Refer to ROC regarding sample preservation discrepancies for samples:

None

Refer to ROC regarding:

None

QC Specified: Yes No If no, chose: _____

ANALYSIS: The following analyte(s) were estimated due to possible matrix interferences:

Co, Pb, Mn, K

DOCUMENT CONTROL: The following invalid defects resulted due to CCS program anomalies:

Initial Assessment: None

Full Assessment: SAM-08-1041, SAM-SAM-08-5011 SAM-10-5011
RR 3/21/11

OTHER: 1. ICP-MS Mean Values in the raw data are incorrect due to TJA software anomalies.
2. Internal Standard calculations in the raw data are reported as the reciprocal values of the %RI (decimal form - not a percentage) with the control limits as stated in the SOW Exhibit D (ICP-MS) Section 12.10.

Signature: _____

Name & Title: _____

Date: 3/21/11

U.S. EPA - CLP

SDG NARRATIVE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: Sentinel, Inc. SOW No.: ISM01.2 Contract: EPW09040
Lab Code: SENTIN Case No.: 41039 NRAS No.: SDG No.: MCO310

EQUATIONS:

AES LW 200.7 Method: Concentration ($\mu\text{g/L}$) = $C \times (V_f/V) \times \text{DF}$

WHERE, C = Instrument value in $\mu\text{g/L}$ (The average of all replicate exposures)
 V_f = Final digestion volume (mL)
V = Initial aliquot amount (mL)
DF = Dilution Factor

AES LS 3050B Method: Concentration (dry wt.) (mg/kg) = $C \times ((V_f / (W \times S)) \times \text{DF} / 1000$

WHERE, C = Instrument Value in $\mu\text{g/L}$ (The average of all replicate exposures)
 V_f = Final sample volume in Liters (mL)
W = Initial aliquot amount (g)
S = % Solids/100
DF = Dilution Factor

AES Wipe/Filter Method: Mass (μg) = $C \times V_f \times \text{DF}/1000$

WHERE, C = Instrument Value in $\mu\text{g/L}$ (The average of all replicate exposures)
 V_f = Final digestion volume (mL)
DF = Dilutions Factor

MS LW 200.8 Method: Concentration ($\mu\text{g/L}$) = $C \times (V_f/V) \times \text{DF}$

WHERE, C = Instrument value in $\mu\text{g/L}$ (The average of all replicate integrations)
 V_f = Final digestion volume (50 mL)
V = Initial aliquot amount (50 mL)
DF = Dilution Factor

MS LS 3050B Method: Concentration (dry wt.) (mg/kg) = $C \times ((V_f / (W \times S)) \times \text{DF} / 1000$

WHERE, C = Instrument Value in $\mu\text{g/L}$ (The average of all replicate exposures)
 V_f = Final sample volume in Liters (mL)
W = Initial aliquot amount (g)
S = % Solids/100
DF = Dilution Factor

Signature: _____

Name & Title: Richard L. Gagne _____

Date: 3/21/11 _____

U.S. EPA - CLP

SDG NARRATIVE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: Sentinel, Inc. SOW No.: ISM01.2 Contract: EPW09040
Lab Code: SENTIN Case No.: 41039 NRAS No.: SDG No.: MC0310

EQUATIONS:

HG LW 7470A Method: Hg Concentration ($\mu\text{g/L}$) = $C \times \text{DF}$

WHERE, C = Instrument response in $\mu\text{g/L}$ Hg from the calibration curve
DF = Dilution Factor

HG LS 7471B Method: Hg Concentration (mg/kg) = $(C \times ((1/(W \times S))) \times \text{DF} \times 0.1$

WHERE, C = Instrument value in $\mu\text{g/L}$ from the calibration curve
W = Initial aliquot amount (g)
S = % Solids/100
DF = Dilution Factor

CN LW Micro Distillation Method: CN Concentration ($\mu\text{g/L}$) = $C \times (V_f/V) \times \text{DF}$

WHERE, C = Instrument response in $\mu\text{g/L}$ CN from the calibration curve
DF = Dilution factor
 V_f = Final prepared volume (mL)
V = Initial aliquot amount (mL)

CN LS Micro Distillation Method: CN Concentration (mg/kg) = $C \times ((V_f / (W \times S)) \times (1/1000) \times \text{DF}$

WHERE, C = Instrument response in $\mu\text{g/L}$ CN from the calibration curve
DF = Dilution factor
 V_f = Final prepared volume (mL)
S = % Solids/100
W = Initial aliquot amount (g)

Signature: _____

Name & Title: _____

Date: _____

3/21/11

SAMPLE LOG-IN SHEET

Received By (Print Name) <u>Randi Richey / Tom Yack</u>	Page <u>01</u>
Received By (Signature) <u>R.D. Richey / Tom Yack</u>	Log-in Date <u>03/09/2011</u>
Case Number <u>41039</u>	Sample Delivery Group No. <u>MC0310</u>
Mod. Ref. No.	

Remarks:	
1. Custody Seal(s)	<u>Present</u> /Absent* <u>Intact</u> /Broken
2. Custody Seal Nos.	<u>NA</u>
3. Traffic Reports/Chain of Custody Records or Packing Lists	<u>Present</u> /Absent*
4. Airbill	<u>Airbill</u> /Sticker <u>Present</u> /Absent*
5. Airbill No.	<u>872927186310</u>
6. Sample Tags	<u>Present</u> /Absent*
Sample Tag Numbers	<u>Listed</u> /Not Listed on Traffic Report/Chain of Custody Record
7. Sample Condition	<u>Intact</u> /Broken*/Leaking
8. Cooler Temperature Indicator Bottle	<u>Present</u> /Absent*
9. Cooler Temperature	<u>2.3°C</u>
10. Does information on Traffic Reports/Chain of Custody Records and sample tags agree?	<u>Yes</u> /No*
11. Date Received at Lab	<u>03/09/2011</u>
12. Time Received	<u>0939</u>

Sample Transfer	
Fraction <u>All</u>	Fraction
Area # <u>Coder</u>	Area #
By <u>RZ</u>	By
On <u>3/9/11</u>	On

	EPA Sample #	Aqueous/Water Sample pH	Corresponding		Remarks: Condition of Sample Shipment, etc.
			Sample Tag #	Assigned Lab #	
1	MC0310	NA	3631	12375	
2	MC0311	NA	3632	12376	
3	MC0312	NA	3634	12377	
4	MC0313	NA	3636	12378	
5	MC0314	NA	3638	12379	
6	MC0315	NA	3644, 3645, 3646	12380	QC
7	MC0316	NA	3648	12381	
8	MC0317	NA	3650	12382	
9	MC0318	NA	3652	12383	
10	MC0319	NA	3654	12384	
11	MC0320	NA	3656	12385	
12	MC0321	NA	3658, 3659, 3660	12386	
13	MC0322	NA	3662	12387	
14					
15					
16					
17					
18					
19					
20					
21					
22					

* Contact SMO and attach record of resolution

Reviewed By <u>[Signature]</u>	Logbook No. <u>2</u>
Date <u>3/21/11</u>	Logbook Page No. <u>20-21</u>

%SOLIDS

Sentinel, Inc. Sample Analysis

% SOLIDS BATCH SHEET

DATE: 3/19/11

ANALYST: TFY/TFY

SDG NO: MC0310

EPA Batch No.: (

EPA Run No: (

	Lab ID No.	Sample Description	Pan Weight, g	Soil & Pan Initial Wt., g	Soil & Pan Final Wt., g	Result, %	Date Analyzed	Analyst Initials
1	12380	MC0315	1.01	9.77	7.84	75.7	3/19/11	TFY/TFY
2	12380D	MC0315D	1.04	9.79	7.67	75.8		
3	12375	MC0310	1.02	9.93	7.44	72.1		
4	12376	MC0311	1.01	9.89	8.12	80.1		
5	12377	MC0312	1.01	9.86	5.37	49.3		
6	12378	MC0313	1.02	9.98	5.22	46.9		
7	12379	MC0314	1.00	9.99	8.97	88.7		
8	12381	MC0316	1.02	9.94	7.28	70.2		
9	12382	MC0317	0.99	9.99	8.67	85.3		
10	12383	MC0318	0.99	9.95	8.31	81.7		
11	12384	MC0319	1.00	9.98	8.00	78.0		
12	12385	MC0320	1.02	9.96	8.31	81.5		
13	12386	MC0321	1.02	9.97	7.82	76.0		
14	12387	MC0322	1.03	9.83	7.74	75.4		
15								
16								
17								
18								
19								
20								
21								

Reviewed By:

RO.D.B. 3/19/11
Inorganic Supervisor/Date

Reviewed By:

RF 3/21/11
QA Officer/Date

**APPENDIX B:
MDE TOXICOLOGICAL
EVALUATION**

**Springfield Mine
Sykesville, Carroll County, Maryland
Toxicological Evaluation**

Summary

This toxicological evaluation examines the human health risks associated with the Springfield Mine in Sykesville, Carroll County, Maryland. This site was evaluated for child recreational visitor (1-6 years), youth recreational visitor (6-17), adult recreational visitor and construction worker populations under a recreational future use scenario. This toxicological evaluation evaluates risks to recreational use populations only. Commercial use scenarios are expected to have greater levels of risk and should be evaluated to reflect appropriate land use scenarios. The United States Environmental Protection Agency (EPA) has recommended default exposure parameters that were used to estimate cumulative risk from all chemicals (4, 5, 6, 7 and 8). EPA recognizes as an acceptable Hazard Index (HI) values less than or equal to 1 (noncarcinogenic chemicals) and excess lifetime cancer risk (CR) less than or equal to 10^{-6} to 10^{-4} . The Maryland Department of the Environment (MDE) recognizes as an acceptable HI values less than or equal to 1 and excess lifetime cancer risk less than or equal to 10^{-6} to 10^{-5} . Based on these exposures, estimated risks at the site were compared to MDE and EPA recommended levels, and the following conclusions were reached:

**Summary table of Hazard Indices (HI) values and Cancer Risk (CR) values
for each recreational population**

Noncarcinogenic Endpoints Detected Contaminants Only			
Population	Pathway	Hazard Index	Risk Drivers
Child recreational visitor	Ingestion – surface soil	14	Cobalt, vanadium
Youth recreational visitor	Ingestion – surface soil	3	Potential additive effects
Construction worker	Ingestion – surface soil	10	Cobalt, vanadium
Adult recreational visitor	Ingestion – surface soil	2	Potential additive effects
Child recreational visitor	Dermal contact – surface soil	13	Chromium, vanadium
Youth recreational visitor	Dermal contact – surface soil	7	Vanadium
Construction worker	Dermal contact – surface soil	7	Vanadium
Adult recreational visitor	Dermal contact – surface soil	2	Potential additive effects
Carcinogenic Endpoints Detected Contaminants Only			
Population	Pathway	Cancer Risk	Risk Drivers
Child recreational visitor	N/A	N/A	N/A
Youth recreational visitor	N/A	N/A	N/A
Adult recreational visitor	N/A	N/A	N/A
Construction worker	N/A	N/A	N/A

Summary table of Hazard Indices (HI) values and Cancer Risk (CR) values for each recreational population utilizing 95% UCL concentrations (soil only)

Noncarcinogenic Endpoints Detected Contaminants Only			
Population	Pathway	Hazard Index	Risk Drivers
Child recreational visitor	Ingestion – surface soil	10	Cobalt, vanadium
Youth recreational visitor	Ingestion – surface soil	2	Potential additive effects
Construction worker	Ingestion – surface soil	7	Cobalt, vanadium
Child recreational visitor	Dermal contact – surface soil	8	Vanadium
Youth recreational visitor	Dermal contact – surface soil	5	Vanadium
Construction worker	Dermal contact – surface soil	4	Vanadium
Carcinogenic Endpoints Detected Contaminants Only			
Population	Pathway	Cancer Risk	Risk Drivers
Child recreational visitor	N/A	N/A	N/A
Youth recreational visitor	N/A	N/A	N/A
Adult recreational visitor	N/A	N/A	N/A
Construction worker	N/A	N/A	N/A

Note: 95%UCL values were calculated for soil exposure pathways only.
 NA = Not applicable; no carcinogenic exposure pathway exceeded a cancer risk of 1×10^{-5} for detected contaminants on site.

Site Description

The approximate 1.2-acre Springfield Mine Naturally Occurring Asbestos (NOA) site is located in a wooded tract of fallow land approximately 900 feet northeast of the Copper Ridge Assisted Living facility at 710 Obrecht Road in Sykesville, Carroll County, Maryland. The site is situated near the center of the 184.3-acre parcel 17 on Carroll County tax map 78 and is zoned for agricultural use.

In 1849 Isaac Tyson, Jr. opened a mine on the estate of maritime shipping magnate William Patterson. The Springfield Iron and Copper Mine operated until 1869, and then reopened briefly in 1881 and again in 1916. The site was originally two openings on adjacent hills separated by a small stream located one mile north of Sykesville. This mine was the chief source of ore for the Elba Furnace (on the Patapsco River, approximately 3/4-mile southeast of Sykesville). The workings featured a main shaft over 300 feet deep. The mines began producing copper at depths of one hundred feet and have since caved in. Otherwise, the lands in the immediate vicinity of the Springfield Mine were fallow. The site is now located on and is feature along a hiking/walking trail with signage identifying the former mine site. The Springfield Mine site is a destination for guided walks for students, rock and mineral collectors and enthusiasts.

There have been no known environmental investigations. MDE is conducting a Preliminary Assessment/Site Inspection to determine if naturally occurring asbestos identified in the former iron-copper mine poses a threat to human health.

1.0 Method

In evaluating risk to human health, maximum concentrations of all chemicals detected in surface soil were compared to medium-specific screening levels (EPA Regional Screening Level Table values and Maryland Department of the Environment Cleanup Standards (1, 2)). Chemicals that exceeded human health Regional Screening Level (RSL) values were then evaluated quantitatively. Relevant toxicological data and RSL values from surrogate compounds (structurally similar analogues) were used for some of the chemicals with no corresponding RSL value. No groundwater samples were collected on the site. Soil samples were collected from locations on the property.

1.1 Human Health

Maximum concentrations of all chemicals detected in soil (dry weight values) were compared to the EPA Regional Screening Level (RSL) table values for residential soil (1). Comparison of dry weight analytical values to the RSLs is recognized as a conservative measure but provides consistency in risk assessments across sites (with variable soil moisture content) and sampling time. Prior to comparison with each chemical concentration, noncarcinogenic RSLs were multiplied by 0.1, in order to account for any additivity of systemic effects. Carcinogenic RSL values were not adjusted and represent a target risk level of 10^{-6} . Carcinogenic and noncarcinogenic risk levels for all contaminants that exceeded their respective RSL screening level were evaluated quantitatively. The quantitative evaluation was based on expected future use and development scenarios and includes populations typically expected to frequent the site

based on this proposed future use. For those soil contaminants identified as potential risk drivers 95% upper confidence limit (95% UCL) values were calculated. The 95% UCL concentrations were used to estimate the exposure point concentrations and quantify potential risks for the soil exposure pathways on site when applicable (3).

The future land use at the site was assumed to be recreational; therefore, the recreational exposure scenario was used to evaluate risk at the site. The contaminants identified at the site at concentrations that exceeded residential RSLs were further evaluated with regard to risk to relevant populations under the following scenarios (4, 5, 6, 7 and 8):

Recreational Development:

Soil:

Adult Recreational Visitor: 30-year exposure duration, 70 kg body weight, 5700 cm² skin surface area (soil), 182 days per year exposure for soil ingestion, 100 mg soil ingested per day, 8 hours inhalation, 0.07 mg/cm²-event soil to skin adherence factor, 0.833 m³/hour inhalation rate, 70-year lifetime.

Construction Worker: 70 kg body weight, 3280 cm² skin surface area (soil), 0.08mg/cm²-event soil to skin adherence factor, 250 days per year exposure for soil ingestion, 480 mg soil ingested per day, 1.5 m³/hour inhalation rate, 8 hour exposure time (inhalation soil), 1 year exposure duration, 70 year lifetime.

Youth Recreational Visitor (6 - 17 years): 40 kg body weight, 4320 cm² skin surface area (soil), 0.07mg/cm²-event soil to skin adherence factor, 182 days per year soil ingestion, 100 mg soil ingested per day, 0.56 m³/hour inhalation rate, 8 hours inhalation exposure, 12 year exposure duration, 70 year lifetime.

Child Recreational Visitor (1 - 6 years): 15 kg body weight, 2350 cm² skin surface area (soil), 0.5mg/cm²-event soil to skin adherence factor, 182 days per year soil ingestion, 200 mg soil ingested per day, 0.32 m³/hour inhalation rate, 8 hour inhalation exposure, 6 year exposure duration, 70 year lifetime.

2.0 Human Health Evaluation

Soil samples were analyzed exclusively for metals. Chemicals that were detected on site were compared to medium-specific screening levels (EPA RSL values). Chemicals that were not detected at the site and exceeded RSL values (at an assumed concentration of one half the detection level) were carried through the quantitative risk assessment and were included in the summation of noncarcinogenic hazard quotients and carcinogenic cancer risk values for comparative purposes only. Chemicals detected at the site that exceeded human health RSL values were evaluated quantitatively using the maximum detected concentration as the site-wide average concentration. Magnesium, calcium, potassium and sodium are essential nutrients that were detected on site and are toxic only at very high concentrations. These compounds are

found naturally in soils in this geographic region, therefore, they are not included in the quantitative risk estimates.

The EPA has issued a directive for lead that recommends a soil screening level of 400 mg/kg for residential scenarios at RCRA facilities and CERCLA sites; the 400-mg/kg soil screening level was used in this evaluation for soil (9).

2.1 Soil

Soil samples were analyzed for metals. No subsurface soils were collected on site. Contaminants that were detected above their respective residential soil RSLs (i.e. failed the initial screening process, see Attachment A) were evaluated quantitatively. Surface and subsurface soil exposures were evaluated via the ingestion, inhalation, dermal contact and vapor intrusion of volatiles to indoor air pathways. Reference dose (RfD) and cancer slope factor (CSF) values were obtained from EPA Regional Table and IRIS (1, 10). Estimates of noncarcinogenic and carcinogenic risks from dermal contact were calculated when sufficient data (permeability constants (11), oral absorption efficiencies and dermal absorption factors (12)) were available.

2.2 Groundwater

No groundwater samples were collected on the site.

2.3 Vapor Intrusion

All volatile and semivolatile contaminants detected in soil on site were quantitatively evaluated for vapor intrusion using the Johnson and Ettinger Tier I vapor intrusion model (13).

2.4 MDE Cleanup Standards Screen

All soil samples collected on site were compared to the MDE *State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater Interim Final Guidance*, June 2008 (2).

3.0 Conclusion

3.1 Soil

Soil analytes that failed the initial screen and had noncarcinogenic or carcinogenic effects via the ingestion, inhalation and dermal contact pathways were evaluated quantitatively. No subsurface soils were collected on site. The estimated noncarcinogenic risks from incidental ingestion of detected surface soil contaminants exceeded MDE and EPA recommended levels of risk for all recreational populations (Table 1) using the maximum detected concentrations as the site wide average concentrations. Cobalt and vanadium were the noncarcinogenic incidental ingestion risk drivers. The estimated noncarcinogenic risks from incidental ingestion of detected surface soil contaminants exceeded MDE and EPA recommended levels of risk for the child recreational visitor, youth recreational visitor and construction worker recreational populations using the 95%

UCL concentrations as the site wide average concentrations (Table 1UCL). Cobalt and vanadium were the noncarcinogenic incidental ingestion risk drivers using the 95% UCL concentrations as the site wide average concentrations. The estimated noncarcinogenic risks from incidental ingestion of detected surface soil contaminants were below MDE and EPA recommended levels of risk for the adult recreational visitor population using the 95% UCL concentrations as the site wide average concentrations. The estimated carcinogenic risks from the incidental ingestion of detected surface soil contaminants were within MDE and EPA recommended risk ranges for all recreational visitor populations (Tables 2 and 2UCL) using both the maximum detected concentrations and 95%UCL concentrations as the site wide average concentrations.

The estimated noncarcinogenic and carcinogenic risks from the inhalation of detected and nondetected volatiles and fugitive dust from surface soils were within acceptable levels as recommended by MDE and EPA for all recreational populations (Tables 3 through 4UCL) using the maximum detected concentrations and 95% UCL concentrations as the site-wide average concentrations.

Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants exceeded MDE and EPA recommended risk levels for all recreational populations (Table 5) using the maximum detected concentrations as the site-wide average concentrations. Chromium, conservatively evaluated as hexavalent chromium, and vanadium were the noncarcinogenic dermal contact risk drivers. Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants exceeded MDE and EPA recommended risk levels for the youth and child recreational visitors and construction worker recreational populations (Table 5UCL) using the 95%UCL concentrations as the site-wide average concentrations. Vanadium was the noncarcinogenic dermal contact risk driver. Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants were below MDE and EPA recommended risk levels for the adult recreational visitor population using the 95%UCL concentrations as the site-wide average concentrations. Risk estimates for dermal exposure to detected carcinogenic surface soil contaminants were within MDE and EPA recommended risk ranges for all recreational populations (Tables 6 and 6UCL) using the maximum detected concentrations and 95%UCL concentrations as the site-wide average concentrations.

The maximum concentration of lead detected in soils on site was less than the recommended 400 mg/kg residential screening level. Based upon these results lead contamination in soils on site should not pose a hazard to recreational land use populations and the environment.

3.2 Groundwater

No groundwater samples were collected on the site.

3.3 Vapor Intrusion

The risk from subsurface vapor intrusion of detected volatile contaminants in soil into buildings was evaluated using the Johnson and Ettinger vapor intrusion model (Attachment B). One detected soil contaminant, mercury, exceeded a Hazard Index of one for vapor intrusion to

indoor air. No detected contaminant in soil exceeded EPA or MDE recommended carcinogenic risk ranges for vapor intrusion to indoor air.

3.4 MDE Cleanup Standards Screen

Maximum concentrations of all chemicals analyzed for in soil were compared to their corresponding MDE residential cleanup standard (Attachment A). Eight detected surface soil contaminants exceeded their MDE residential soil cleanup standard. Three of the surface soil contaminants exceeding the residential cleanup standards, aluminum, arsenic and thallium had 95% UCL concentrations less than their corresponding anticipated typical concentrations (ATC) for this region of the State. The two primary soil risk drivers identified at the site, vanadium and chromium, had 95%UCL values and mean concentration values near their ATC values for this region of the State. Any consideration of hazards associated with previous site activities should consider further evaluations of regional background metal concentrations before further assessments are performed. All contaminants that exceeded their respective residential cleanup standard and all detected volatile contaminants were evaluated quantitatively.

3.5 Evaluation Assumptions

When determining whether an increased risk to human health exists at this site, it is important to understand that this evaluation was prepared as a first level screening evaluation. Many conservative assumptions are included in this evaluation, which were developed with the understanding that if the estimated risk, using the conservative assumptions, does not exceed EPA's recommended levels, then the risk estimated using more realistic scenarios will not exceed these levels.

Since this evaluation includes many conservative assumptions, a risk that exceeds EPA's recommended level of risk does not necessarily indicate an increased risk to human health. When this situation occurs, it is necessary to consider several points when determining if the risk actually does represent a threat to human health. For example, the quantitative risk estimate in this evaluation assumes people will be exposed to a contaminant at the maximum concentration all throughout the site and for the entire exposure duration. These assumptions do not take into account whether the maximum concentration is anomalous or characteristic of the site, or that biodegradation, dispersion, dilution, or other factors may decrease the contaminant concentration throughout the time of exposure.

This evaluation also assumes that the bioavailability of each contaminant is 100 percent, and that all of the contaminant taken into the body is absorbed across the digestive tract into the body. A chemical is harmful to human health only if it is absorbed into the body. Assuming complete bioavailability does not consider the fact that it is common for a fraction of the chemical taken into the body to be excreted rather than absorbed into the body. The bioavailability of a contaminant is dependent on many factors, such as the state or form of the contaminant and if the actual size of the contaminant particle would permit incidental ingestion. These issues must be considered when evaluating the appropriateness of assuming total bioavailability of a contaminant.

4.0 References

1. EPA, Regional Screening Level Table, May, 2010.
2. Maryland Department of the Environment. *State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater*. Interim Final Guidance. June, 2009.
3. USEPA, Supplemental Guidance to the RAGS: Calculating the Concentration Term. May 1992. Publication 9285.7-081.
4. EPA. 1989. *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) Interim Final*. Office of Emergency and Remedial Response. EPA/540/1-89/002.
5. EPA. 1991. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance "Standard Default Exposure Factors" Interim Final*. Office of Emergency and Remedial Response. OSWER Directive: 9285.6-03.
6. EPA. 1991. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk/based Preliminary Remediation Goals) Interim*. Office of Emergency and Remedial Response. EPA/540/R-92/003.
7. USEPA, Risk Assessment Guidance for Superfund Volume 1, Human Health Evaluation Manual (Part E – Supplemental Guidance for Dermal Risk Assessment Final), July 2004, OSWER 9285.7-02EP (EPA/540/R/99/005).
8. EPA. 1997. *Exposure Factors Handbook, Volume I, General Factors*. Office of Research and Development. EPA/600/P-95/002Fa.
9. EPA. *Memorandum: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*. Office of Solid Waste and Emergency Response. OSWER Directive # 9355.4-12.
10. EPA. Integrated Risk Information System. 2009.
11. EPA. 1992. *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B.
12. EPA. Region III, 1995. *Technical Guidance Manual, Risk Assessment, Assessing Dermal Exposure from Soil*. EPA/903-K-95-003.
13. EPA. *User's Guide for the Johnson and Ettinger (1991) Model for subsurface Vapor Intrusion into Buildings*. Version 3.1; 02/04.

TABLES

Table 1. Quantitative Risk Assessment - Noncarcinogenic Residential Use - Incidental Ingestion/Surface Soil For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)		Adult Resident		Construction Worker		Youth Resident		Child Resident	
			ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	22300		2E-02	2E-02	1E-01	1E-01	3E-02	3E-02	1E-01	1E-01	1E-01	1E-01
ARSENIC	4.9		3E-06	1E-02	2E-05	8E-02	6E-06	2E-02	3E-05	1E-01	3E-05	1E-01
CHROMIUM	249		2E-04	6E-02	1E-03	4E-01	3E-04	1E-01	2E-03	6E-01	2E-03	6E-01
COBALT	146	J	1E-04	3E-01	7E-04	2E+00 *	2E-04	6E-01	1E-03	3E+00 *	1E-03	3E+00 *
COPPER	4630		3E-03	8E-02	2E-02	5E-01	6E-03	1E-01	3E-02	8E-01	3E-02	8E-01
IRON	103000		7E-02	1E-01	5E-01	7E-01	1E-01	2E-01	7E-01	1E+00	7E-01	1E+00
MANGANESE (WATER)	2380	J	2E-03	7E-02	1E-02	5E-01	3E-03	1E-01	2E-02	7E-01	2E-02	7E-01
MERCURY	0.77		5E-07	3E-03	4E-06	2E-02	1E-06	6E-03	5E-06	3E-02	5E-06	3E-02
THALLIUM	2.5		2E-06	3E-02	1E-05	2E-01	3E-06	5E-02	2E-05	3E-01	2E-05	3E-01
VANADIUM	80.4		6E-05	8E-01	4E-04	5E+00 *	1E-04	1E+00	5E-04	8E+00 *	5E-04	8E+00 *
Hazard Index for Detected Compounds Only:			Sum =	1.5E+00 *	Sum =	1.0E+01 *	Sum =	2.7E+00 *	Sum =	1.4E+01 *	Sum =	1.4E+01 *
Hazard Index for Detected and Nondetected Compounds:			Sum =	1.5E+00 *	Sum =	1.0E+01 *	Sum =	2.7E+00 *	Sum =	1.4E+01 *	Sum =	1.4E+01 *

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.
 * Hazard quotient or hazard index exceeds 1.5.

**Table IUCL. Quantitative Risk Assessment - Noncarcinogenic
Residential Use - Incidental Ingestion/Surface Soil
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)		Adult Resident		Construction Worker		Youth Resident		Child Resident	
			ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	15772	UCL	1E+00	1E-02	1E-02	1E-02	7E-02	7E-02	2E-02	2E-02	1E-01	1E-01
ARSENIC	2,908	UCL	3E-04	2E-06	2E-06	7E-03	1E-05	5E-02	4E-06	1E-02	2E-05	6E-02
CHROMIUM	143	UCL	3E-03	1E-04	1E-04	3E-02	7E-04	2E-01	2E-04	6E-02	1E-03	3E-01
COBALT	138.7	UCL	3E-04	1E-04	1E-04	3E-01	7E-04	2E+00 *	2E-04	6E-01	9E-04	3E+00 *
COPPER	1929	UCL	4E-02	1E-03	1E-03	3E-02	9E-03	2E-01	2E-03	6E-02	1E-02	3E-01
IRON	62060	UCL	7E-01	4E-02	4E-02	6E-02	3E-01	4E-01	8E-02	1E-01	4E-01	6E-01
MANGANESE (WATER)	1600	UCL	2E-02	1E-03	1E-03	5E-02	8E-03	3E-01	2E-03	8E-02	1E-02	4E-01
THALLIUM	0.912	UCL	6E-05	6E-07	6E-07	1E-02	4E-06	7E-02	1E-06	2E-02	6E-06	9E-02
VANADIUM	50.24	UCL	7E-05	4E-05	4E-05	5E-01	2E-04	3E+00 *	6E-05	9E-01	3E-04	5E+00 *
Hazard Index for Detected Compounds Only:			Sum =	1.0E+00	Sum =	6.9E+00 *	Sum =	1.8E+00 *	Sum =	9.8E+00 *	Sum =	9.8E+00 *
Hazard Index for Detected and Nondetected Compounds:			Sum =	1.0E+00	Sum =	6.9E+00 *	Sum =	1.8E+00 *	Sum =	9.8E+00 *	Sum =	9.8E+00 *

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

**Table 2. Quantitative Risk Assessment - Carcinogenic
Residential Use - Incidental Ingestion/Surface soil.
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Slope Factor (1/mg/kg/d)	Adult Resident		Construction Worker		Youth Resident		Child Resident	
			LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	4.9	2E+00	1E-06	2E-06	3E-07	5E-07	1E-06	2E-06	3E-06	4E-06
Cancer Risk for Detected Compounds Only:			Sum =	2.2E-06	Sum =	4.9E-07	Sum =	1.6E-06	Sum =	4.2E-06
Cancer Risk for Detected and Nondetected Compounds:			Sum =	2.2E-06	Sum =	4.9E-07	Sum =	1.6E-06	Sum =	4.2E-06

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.
* Cancer risk exceeds 10E-4. "m" - Mutagen

**Table 2UCL. Quantitative Risk Assessment - Carcinogenic
Residential Use - Incidental Ingestion/Surface soil.
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Resident		Construction Worker		Youth Resident		Child Resident	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	2.908	UCL	2E+00	9E-07	1E-06	2E-07	3E-07	6E-07	9E-07	2E-06	2E-06
Cancer Risk for Detected Compounds Only:				Sum =	1.3E-06	Sum =	2.9E-07	Sum =	9.3E-07	Sum =	2.5E-06
Cancer Risk for Detected and Nondetected Compounds:				Sum =	1.3E-06	Sum =	2.9E-07	Sum =	9.3E-07	Sum =	2.5E-06

LADD = Lifetime average daily dose (mg/kg/d). CR= Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds 10E-4. "m" - Mutagen

**Table 3. Quantitative Risk Assessment - Noncarcinogenic
Residential Use - Inhalation of Volatiles and Fugitive Dust (Surface Soil).
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)		Adult Resident		Construction Worker		Youth Resident		Child Resident	
			PEF/VF	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Particulate Emission:												
ALUMINUM	22300		5E-03	4E-03		2E-03		4E-03		4E-03		4E-03
ARSENIC	4.9		2E-05	3E-04		1E-04		3E-04		3E-04		3E-04
CHROMIUM	249		1E-04	2E-03		1E-03		2E-03		2E-03		2E-03
COBALT	146	J	6E-06	2E-02		1E-02		2E-02		2E-02		2E-02
MANGANESE (WATER)	2380	J	5E-05	4E-02		2E-02		4E-02		4E-02		4E-02
MERCURY	0.77		3E-04	2E-06		1E-06		2E-06		2E-06		2E-06
Volatilization:												
ALUMINUM	22300		5E-03									
ARSENIC	4.9		2E-05									
CHROMIUM	249		1E-04									
COBALT	146	J	6E-06									
MANGANESE (WATER)	2380	J	5E-05									
MERCURY	0.77		3E-04									
VF												
			2.10E+04	6E-02		3E-02		6E-02		6E-02		6E-02
Particle Hazard Index for Detected Compounds Only:				Sum = 7.0E-02		Sum = 3.2E-02		Sum = 7.0E-02		Sum = 7.0E-02		Sum = 7.0E-02
Volatile Hazard Index for Detected Compounds Only:				Sum = 6.1E-02		Sum = 2.8E-02		Sum = 6.1E-02		Sum = 6.1E-02		Sum = 6.1E-02
Total Cancer Risk via Inhalation (Detected and nondetected compounds):				Sum = 1.3E-01		Sum = 6.0E-02		Sum = 1.3E-01		Sum = 1.3E-01		Sum = 1.3E-01

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

**Table 4. Quantitative Risk Assessment - Carcinogenic
Residential Use - Inhalation of Volatiles and Fugitive Dust (Surface Soil).
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor / IUR	PEF/VF		Adult Resident		Construction Worker		Youth Resident		Child Resident	
				PEF	VF	LADD	CR	LADD	CR	LADD	CR	LADD	CR
Particulate Emission:													
ARSENIC	4.9		4E-03	5.66E+08		8E-09		1E-10		3E-09		2E-09	
CHROMIUM	249		8E-02	5.66E+08		8E-06		1E-07		3E-06		2E-06	
COBALT	146	J	9E-03	5.66E+08		5E-07		8E-09		2E-07		1E-07	
Volatilization:													
VF													
ARSENIC	4.9		4E-03										
CHROMIUM	249		8E-02										
COBALT	146	J	9E-03										
Particle Cancer Risk Totals for Detected Compounds Only:				Sum =	8.4E-06	Sum =	1.3E-07	Sum =	3.4E-06	Sum =	1.7E-06		
Volatile Cancer Risk Totals for Detected Compounds Only:				Sum =	--	Sum =	--	Sum =	--	Sum =	--		
Total Cancer Risk via Inhalation (Detected and nondetected compounds):				Sum =	8.4E-06	Sum =	1.3E-07	Sum =	3.4E-06	Sum =	1.7E-06		

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds 10E-4. m - Mutagen

**Table 4UCL. Quantitative Risk Assessment - Carcinogenic
Residential Use - Inhalation of Volatiles and Fugitive Dust (Surface Soil).
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor/ IUR	PEF/VF	Adult Resident		Construction Worker		Youth Resident		Child Resident		
					LADD	CR	LADD	CR	LADD	CR	LADD	CR	
Particulate Emission:													
ARSENIC	2,908	UCL	4E-03	5.66E+08	5E-09	7E-11	2E-09	9E-10					
CHROMIUM	143	UCL	8E-02	5.66E+08	5E-06	7E-08	2E-06	9E-07					
COBALT	138.7	UCL	9E-03	5.66E+08	5E-07	7E-09	2E-07	9E-08					
Volatilization:													
					VF								
ARSENIC	2,908	UCL	4E-03										
CHROMIUM	143	UCL	8E-02										
COBALT	138.7	UCL	9E-03										
Particle Cancer Risk Totals for Detected Compounds Only:					Sum =	5.0E-06	Sum =	7.6E-08	Sum =	2.0E-06	Sum =	1.0E-06	
Volatle Cancer Risk Totals for Detected Compounds Only:					Sum =	--	Sum =	--	Sum =	--	Sum =	--	
Total Cancer Risk via Inhalation (Detected and nondetected compounds):					Sum =	5.0E-06	Sum =	7.6E-08	Sum =	2.0E-06	Sum =	1.0E-06	

LADD = lifetime average daily dose (mg/kg/d). CR= Cancer risk. Compounds printed in lowercase letters were not detected in any sample.
* Cancer risk exceeds 10E-4. m - Mutagen

Table 5. Quantitative Risk Assessment - Noncarcinogenic Residential Use - Dermal Contact/Surface Soil For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)		Adult Resident		Construction Worker		Youth Resident		Child Resident	
			ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	22300		6E-04	2E-03	2E-03	8E-03	2E-03	8E-03	2E-03	9E-03	4E-03	2E-02
ARSENIC	4.9		4E-07	1E-03	1E-06	5E-03	1E-06	5E-03	2E-06	5E-03	3E-06	9E-03
CHROMIUM	249		7E-06	2E-01	2E-05	8E-01	2E-05	8E-01	3E-05	9E-01	5E-05	2E+00 *
COBALT	146	J	4E-06	5E-02	1E-05	2E-01	1E-05	2E-01	2E-05	2E-01	3E-05	3E-01
COPPER	4630		1E-04	3E-03	4E-04	1E-02	4E-04	1E-02	5E-04	1E-02	9E-04	2E-02
IRON	103000		3E-03	2E-02	1E-02	7E-02	1E-02	7E-02	1E-02	8E-02	2E-02	1E-01
THALLIUM	2.5		7E-08	1E-03	2E-07	4E-03	2E-07	4E-03	3E-07	4E-03	5E-07	7E-03
VANADIUM	80.4		2E-06	2E+00 *	8E-06	6E+00 *	8E-06	6E+00 *	9E-06	6E+00 *	1E-05	1E+01 *
Hazard Index for Detected Compounds Only:			Sum =	1.9E+00 *	Sum =	6.6E+00 *	Sum =	6.6E+00 *	Sum =	7.4E+00 *	Sum =	1.3E+01 *
Hazard Index for Detected and Nondetected Compounds:			Sum =	1.9E+00 *	Sum =	6.6E+00 *	Sum =	6.6E+00 *	Sum =	7.4E+00 *	Sum =	1.3E+01 *

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

**Table 5UCL. Quantitative Risk Assessment - Noncarcinogenic
Residential Use - Dermal Contact/Surface Soil
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)		Adult Resident		Construction Worker		Youth Resident		Child Resident	
			ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	15772	UCL	3E-01	2E-03	4E-04	2E-03	2E-03	6E-03	2E-03	6E-03	3E-03	1E-02
ARSENIC	2.908	UCL	3E-04	8E-04	2E-07	8E-04	8E-07	3E-03	9E-07	3E-03	2E-06	5E-03
CHROMIUM	143	UCL	3E-05	1E-01	4E-06	1E-01	1E-05	5E-01	2E-05	5E-01	3E-05	9E-01
COBALT	138.7	UCL	9E-05	4E-02	4E-06	4E-02	1E-05	1E-01	1E-05	2E-01	3E-05	3E-01
COPPER	1929	UCL	4E-02	1E-03	5E-05	1E-03	2E-04	5E-03	2E-04	5E-03	4E-04	9E-03
IRON	62060	UCL	1E-01	1E-02	2E-03	1E-02	6E-03	4E-02	7E-03	5E-02	1E-02	8E-02
THALLIUM	0.912	UCL	6E-05	4E-04	3E-08	4E-04	9E-08	1E-03	1E-07	2E-03	2E-07	3E-03
VANADIUM	50.24	UCL	1E-06	1E+00	1E-06	1E+00	5E-06	3E+00 *	5E-06	4E+00 *	9E-06	7E+00 *
Hazard Index for Detected Compounds Only:			Sum =	1.2E+00	Sum =	4.1E+00 *	Sum =	4.6E+00 *	Sum =	8.0E+00 *	Sum =	8.0E+00 *
Hazard Index for Detected and Nondetected Compounds:			Sum =	1.2E+00	Sum =	4.1E+00 *	Sum =	4.6E+00 *	Sum =	8.0E+00 *	Sum =	8.0E+00 *

ADD = average daily dose (mg/kg/d), HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

**Table 6. Quantitative Risk Assessment - Carcinogenic
Residential Use - Dermal Contact/Surface soil.
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Resident		Construction Worker		Youth Resident		Child Resident	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	4.9		2E+00	2E-07	3E-07	2E-08	3E-08	3E-07	4E-07	2E-07	4E-07
	Cancer Risk for Detected Compounds Only:			Sum =	2.7E-07	Sum =	3.0E-08	Sum =	4.1E-07	Sum =	3.5E-07
	Cancer Risk for Detected and Nondetected Compounds:			Sum =	2.7E-07	Sum =	3.0E-08	Sum =	4.1E-07	Sum =	3.5E-07

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.
* Cancer risk exceeds 10E-4. m - Mutagen

**Table 6UCL. Quantitative Risk Assessment - Carcinogenic
Residential Use - Dermal Contact/Surface soil.
For Springfield Mine, 710 Obrecht Road, Sykesville, Carroll County, Maryland.**

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Resident		Construction Worker		Youth Resident		Child Resident	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	2.908	UCL	2E+00	1E-07	2E-07	1E-08	2E-08	2E-07	2E-07	1E-07	2E-07
Cancer Risk for Detected Compounds Only:				Sum =	1.6E-07	Sum =	1.8E-08	Sum =	2.4E-07	Sum =	2.1E-07
Cancer Risk for Detected and Nondetected Compounds:				Sum =	1.6E-07	Sum =	1.8E-08	Sum =	2.4E-07	Sum =	2.1E-07

LADD = lifetime average daily dose (mg/kg/d). CR= Cancer risk. Compounds printed in lowercase letters were not detected in any sample.
* Cancer risk exceeds 10E-4. m - Mutagen

ATTACHMENTS

ATTACHMENT A

Attachment A. Identification of Chemicals of Concern (Residential): Springfield Mine, Sykesville, Carroll County, Maryland; PCA Code: 69013

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	MDE Groundwater Standard	Pass Tier 1 Screen ?	MDE Soil Standard (Residential)	Pass Tier 1 Screen ?
Surface:										
No Standards Available										
S-12	CALCIUM		Soil	18900	J	mg/Kg	--	--		?
S-13	MAGNESIUM		Soil	12900		mg/Kg	--	--		?
S-13	POTASSIUM		Soil	4440	J	mg/Kg	--	--		?
S-12	SODIUM		Soil	228	J	mg/Kg	--	--		?
Inorganics:										
S-9	ALUMINUM	7429905	Soil	22300		mg/Kg	--	--	7.82E+03	Fail
S-2	ANTIMONY	7440360	Soil	0.8	J	mg/Kg	--	--	3.13E+00	Pass
S-1	ARSENIC	7440382	Soil	4.9		mg/Kg	--	--	4.26E-01	Fail
S-12	BARIUM	7440393	Soil	133		mg/Kg	--	--	1.56E+03	Pass
S-13	BERYLLIUM	7440417	Soil	2.5	UL	mg/Kg	--	--	1.56E+01	Pass
S-7	CADMIUM (diet)	7440439	Soil	1.1		mg/Kg	--	--	3.91E+00	Pass
S-6	CHROMIUM	18540299	Soil	249		mg/Kg	--	--	2.35E+01	Fail
S-13	COBALT		Soil	146	J	mg/Kg	--	--		?
S-7	COPPER	7440508	Soil	4630		mg/Kg	--	--	3.13E+02	Fail
S-5	IRON	7439896	Soil	103000		mg/Kg	--	--	5.48E+03	Fail
S-1	LEAD	7439921	Soil	48.2	J	mg/Kg	--	--	4.00E+02	Pass
S-12	MANGANESE (water)	7439965	Soil	2380	J	mg/Kg	--	--	1.56E+02	Fail
S-13	MERCURY	7439976	Soil	0.77		mg/Kg	--	--		?
S-6	NICKEL	7440020	Soil	111		mg/Kg	--	--	1.56E+02	Pass
S-13	SELENIUM	7782492	Soil	1.75	UL	mg/Kg	--	--	3.91E+01	Pass
S-13	SILVER	7440224	Soil	3.4		mg/Kg	--	--	3.91E+01	Pass
S-13	THALLIUM	7440280	Soil	2.5		mg/Kg	--	--	5.48E-01	Fail
S-2	VANADIUM	7440622	Soil	80.4		mg/Kg	--	--	7.82E+00	Fail
S-7	ZINC	7440666	Soil	1740		mg/Kg	--	--	2.35E+03	Pass

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Attachment A. Identification of Chemicals of Concern: Springfield Mine, Sykesville, Carroll County, Maryland; PCA Code: 69013

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	Adjusted Tap Water RBC	Pass Tier 1 Screen ?	Adjusted Soil RBC (Residential)	Pass Tier 1 Screen ?
Soil										
Surface:										
No RBCs Available										
S-12	CALCIUM		Soil	18900	J	mg/Kg	--	--		?
S-13	MAGNESIUM		Soil	12900		mg/Kg	--	--		?
S-13	POTASSIUM		Soil	4440	J	mg/Kg	--	--		?
S-12	SODIUM		Soil	228	J	mg/Kg	--	--		?
Inorganics:										
S-9	ALUMINUM	7429905	Soil	22300		mg/Kg	--	--	7.70E+03	N
S-2	ANTIMONY	7440360	Soil	0.8	J	mg/Kg	--	--	3.10E+00	N
S-1	ARSENIC	7440382	Soil	4.9		mg/Kg	--	--	3.90E-01	C
S-12	BARIUM	7440393	Soil	133		mg/Kg	--	--	1.50E+03	N
S-13	BERYLLIUM	7440417	Soil	2.5	UL	mg/Kg	--	--	1.60E+01	N
S-7	CADMIUM (diet)	7440439	Soil	1.1		mg/Kg	--	--	7.00E+00	N
S-6	CHROMIUM	18540299	Soil	249		mg/Kg	--	--	2.30E+01	N
S-13	COBALT	7440484	Soil	146	J	mg/Kg	--	--	2.30E+00	N
S-7	COPPER	7440508	Soil	4630		mg/Kg	--	--	3.10E+02	N
S-5	IRON	7439896	Soil	103000		mg/Kg	--	--	5.50E+03	N
S-1	LEAD	7439921	Soil	48.2	J	mg/Kg	--	--	4.00E+01	N
S-12	MANGANESE (water)	7439965	Soil	2380	J	mg/Kg	--	--	1.80E+02	N
S-13	MERCURY	7439976	Soil	0.77		mg/Kg	--	--	5.60E-01	N
S-6	NICKEL	7440020	Soil	111		mg/Kg	--	--	1.50E+02	N
S-1	SELENIUM	7782492	Soil	1.75	UL	mg/Kg	--	--	3.90E+01	N
S-13	SILVER	7440224	Soil	3.4		mg/Kg	--	--	3.90E+01	N
S-13	THALLIUM	7440280	Soil	2.5		mg/Kg	--	--	5.10E-01	N
S-2	VANADIUM	7440622	Soil	80.4		mg/Kg	--	--	5.50E-01	N
S-7	ZINC	7440666	Soil	1740		mg/Kg	--	--	2.30E+03	N

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	ALUMINUM	Soil					
				S			
				S-9	22300.0000		mg/Kg
				S-8	17500.0000		mg/Kg
				S-7	8020.0000		mg/Kg
				S-6	8790.0000		mg/Kg
				S-5	9310.0000		mg/Kg
				S-4	6050.0000		mg/Kg
				S-3	6220.0000		mg/Kg
				S-2	21200.0000		mg/Kg
				S-13	13700.0000		mg/Kg
				S-11	9920.0000		mg/Kg
				S-10	18300.0000		mg/Kg
				S-1	17400.0000		mg/Kg
				S-12	9500.0000		mg/Kg

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	ARSENIC	Soil					
				S			
				S-9	3.4000		mg/Kg
				S-8	2.6000		mg/Kg
				S-7	0.3000	J	mg/Kg
				S-6	1.9000		mg/Kg
				S-5	1.7000		mg/Kg
				S-4	0.3900	J	mg/Kg
				S-3	0.6400	J	mg/Kg
				S-2	3.1000		mg/Kg
				S-13	0.5000	U	mg/Kg
				S-11	3.2000		mg/Kg
				S-10	3.1000		mg/Kg
				S-1	4.9000		mg/Kg
				S-12	2.9000		mg/Kg

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	CHROMIUM	Soil					
				S-9	34.3000		mg/Kg
				S-8	37.6000		mg/Kg
				S-7	116.0000		mg/Kg
				S-6	249.0000		mg/Kg
				S-5	220.0000		mg/Kg
				S-4	74.6000		mg/Kg
				S-3	95.6000		mg/Kg
				S-2	126.0000		mg/Kg
				S-13	96.8000		mg/Kg
				S-10	38.4000		mg/Kg
				S-1	120.0000		mg/Kg
				S-12	29.1000		mg/Kg
				S-11	45.7000		mg/Kg

ANALYTE MAX REPORT

PCAcide	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	COBALT	Soil					
				S-9	12.1000	J	mg/Kg
				S-8	21.0000	J	mg/Kg
				S-7	130.0000	J	mg/Kg
				S-6	102.0000	J	mg/Kg
				S-5	122.0000	J	mg/Kg
				S-4	134.0000	J	mg/Kg
				S-3	112.0000	J	mg/Kg
				S-2	39.7000	J	mg/Kg
				S-13	146.0000	J	mg/Kg
				S-10	17.5000	J	mg/Kg
				S-1	94.3000		mg/Kg
				S-12	19.6000	J	mg/Kg
				S-11	22.5000	J	mg/Kg

ANALYTE MAX REPORT

PCAcide	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	COPPER						
		Soil					
				S			
				S-9	80.3000		mg/Kg
				S-8	97.6000		mg/Kg
				S-7	4630.0000		mg/Kg
				S-6	1500.0000		mg/Kg
				S-5	1330.0000		mg/Kg
				S-4	771.0000		mg/Kg
				S-3	669.0000		mg/Kg
				S-2	58.6000		mg/Kg
				S-13	1200.0000		mg/Kg
				S-12	31.2000		mg/Kg
				S-10	32.2000		mg/Kg
				S-1	695.0000		mg/Kg
				S-11	32.6000		mg/Kg

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	IRON	Soil					
				S			
				S-9	36600.0000		mg/Kg
				S-8	31900.0000		mg/Kg
				S-7	55700.0000		mg/Kg
				S-6	93200.0000		mg/Kg
				S-5	103000.0000		mg/Kg
				S-4	62300.0000		mg/Kg
				S-3	60600.0000		mg/Kg
				S-2	40300.0000		mg/Kg
				S-13	33500.0000		mg/Kg
				S-12	18000.0000		mg/Kg
				S-10	24400.0000		mg/Kg
				S-1	55300.0000		mg/Kg
				S-11	23600.0000		mg/Kg

ANALYTE MAX REPORT

PC Acode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	MANGANESE (water)						
		Soil					
				S			
				S-9	59.5000		mg/Kg
				S-9	211.0000	J	mg/Kg
				S-8	395.0000	J	mg/Kg
				S-7	233.0000	J	mg/Kg
				S-6	467.0000	J	mg/Kg
				S-5	304.0000	J	mg/Kg
				S-4	545.0000	J	mg/Kg
				S-3	511.0000	J	mg/Kg
				S-2	1640.0000	J	mg/Kg
				S-13	207.0000	J	mg/Kg
				S-12	2380.0000	J	mg/Kg
				S-10	504.0000	J	mg/Kg
				S-1	1380.0000	J	mg/Kg
				S-11	1930.0000	J	mg/Kg

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	MERCURY	Soil					
				S-9	0.0530	J	mg/Kg
				S-8	0.0420	J	mg/Kg
				S-7	0.1600		mg/Kg
				S-6	0.1400		mg/Kg
				S-5	0.2300		mg/Kg
				S-4	0.7100	J	mg/Kg
				S-3	0.0770	J	mg/Kg
				S-2	0.4900	J	mg/Kg
				S-13	0.7700		mg/Kg
				S-12	0.1200	J	mg/Kg
				S-10	0.0240	J	mg/Kg
				S-1	0.1200	J	mg/Kg
				S-11	0.1200	J	mg/Kg

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	THALLIUM	Soil					
				S			
				S-9	1.2500	U	mg/Kg
				S-8	1.2500	U	mg/Kg
				S-7	1.2500	U	mg/Kg
				S-6	0.5600	B	mg/Kg
				S-5	0.5400	B	mg/Kg
				S-4	0.1600	B	mg/Kg
				S-3	0.3800	B	mg/Kg
				S-2	1.2500	U	mg/Kg
				S-13	2.5000		mg/Kg
				S-12	1.2500	U	mg/Kg
				S-10	1.2500	U	mg/Kg
				S-1	1.2500	U	mg/Kg
				S-11	1.2500	U	mg/Kg

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
69013	VANADIUM	Soil					
				S			
				S-9	49.5000		mg/Kg
				S-8	46.8000		mg/Kg
				S-7	28.3000		mg/Kg
				S-6	41.9000		mg/Kg
				S-5	41.6000		mg/Kg
				S-4	33.7000		mg/Kg
				S-3	35.9000		mg/Kg
				S-2	80.4000		mg/Kg
				S-13	28.0000		mg/Kg
				S-12	30.2000		mg/Kg
				S-10	41.7000		mg/Kg
				S-1	58.2000		mg/Kg
				S-11	40.9000		mg/Kg

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

AI S

General Statistics

Number of Valid Observations	13	Number of Distinct Observations	13
------------------------------	----	---------------------------------	----

Raw Statistics

Minimum	6050
Maximum	22300
Mean	12939
Median	9920
SD	5730
Coefficient of Variation	0.443
Skewness	0.411

Log-transformed Statistics

Minimum of Log Data	8.708
Maximum of Log Data	10.01
Mean of log Data	9.374
SD of log Data	0.456

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.894
Shapiro Wilk Critical Value	0.866

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.916
Shapiro Wilk Critical Value	0.866

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	15772
95% UCLs (Adjusted for Skewness)	
95% Adjusted-CLT UCL	15747
95% Modified-t UCL	15802

Assuming Lognormal Distribution

95% H-UCL	17144
95% Chebyshev (MVUE) UCL	20256
97.5% Chebyshev (MVUE) UCL	23414
99% Chebyshev (MVUE) UCL	29618

Gamma Distribution Test

k star (bias corrected)	4.268
Theta Star	3031
nu star	111
Approximate Chi Square Value (.05)	87.66
Adjusted Level of Significance	0.0301
Adjusted Chi Square Value	84.71

Anderson-Darling Test Statistic	0.534
Anderson-Darling 5% Critical Value	0.736
Kolmogorov-Smirnov Test Statistic	0.212
Kolmogorov-Smirnov 5% Critical Value	0.237

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	16381
95% Adjusted Gamma UCL	16951

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	15553
95% Jaokknife UCL	15772
95% Standard Bootstrap UCL	15453
95% Bootstrap-t UCL	16162
95% Hall's Bootstrap UCL	15503
95% Percentile Bootstrap UCL	15491
95% BCA Bootstrap UCL	15738
95% Chebyshev(Mean, Sd) UCL	19867
97.5% Chebyshev(Mean, Sd) UCL	22864
99% Chebyshev(Mean, Sd) UCL	28752

Potential UCL to Use

Use 95% Student's-t UCL 15772

As S

General Statistics

Number of Valid Data	13	Number of Detected Data	12
Number of Distinct Detected Data	11	Number of Non-Detect Data	1
		Percent Non-Detects	7.69%

Raw Statistics

Minimum Detected	0.3
Maximum Detected	4.9
Mean of Detected	2.344
SD of Detected	1.395
Minimum Non-Detect	0.5
Maximum Non-Detect	0.5

Log-transformed Statistics

Minimum Detected	-1.204
Maximum Detected	1.589
Mean of Detected	0.57
SD of Detected	0.92
Minimum Non-Detect	-0.693
Maximum Non-Detect	-0.693

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.93
5% Shapiro Wilk Critical Value	0.859

Data appear Normal at 5% Significance Level

Lognormal Distribution Test: with Detected Values Only

Shapiro Wilk Test Statistic	0.824
5% Shapiro Wilk Critical Value	0.859

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

Mean	2.183
SD	1.457
95% DL/2 (t) UCL	2.903

Assuming Lognormal Distribution

DL/2 Substitution Method

Mean	0.42
SD	1.035
95% H-Stat (DL/2) UCL	4.848

Maximum Likelihood Estimate(MLE) Method

Mean	2.015
SD	1.678
95% MLE (t) UCL	2.845
95% MLE (Tiku) UCL	2.892

Log ROS Method

Mean in Log Scale	0.47
SD in Log Scale	0.952
Mean in Original Scale	2.201
SD in Original Scale	1.432
95% Percentile Bootstrap UCL	2.829
95% BCA Bootstrap UCL	2.829

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	1.498
Theta Star	1.565
nu star	35.95

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

A-D Test Statistic	0.803
5% A-D Critical Value	0.742
K-S Test Statistic	0.742
5% K-S Critical Value	0.249

Data follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	2.19
SD	1.39
SE of Mean	0.403
95% KM (t) UCL	2.908
95% KM (z) UCL	2.853
95% KM (jackknife) UCL	2.905

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.3	95% KM (bootstrap t) UCL	2.951
Maximum	4.9	95% KM (BCA) UCL	2.877
Mean	2.202	95% KM (Percentile Bootstrap) UCL	2.831
Median	2.6	95% KM (Chebyshev) UCL	3.945
SD	1.43	97.5% KM (Chebyshev) UCL	4.704
k star	1.379	99% KM (Chebyshev) UCL	6.196
Theta star	1.597		
Nu star	35.85	Potential UCLs to Use	
AppChi2	23.15	95% KM (t) UCL	2.908
95% Gamma Approximate UCL	3.411	95% KM (Percentile Bootstrap) UCL	2.831
95% Adjusted Gamma UCL	3.638		

Note: DL/2 is not a recommended method.

Cr S

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		Log-transformed Statistics	
Minimum	29.1	Minimum of Log Data	3.371
Maximum	249	Maximum of Log Data	5.517
Mean	98.7	Mean of log Data	4.364
Median	95.6	SD of log Data	0.71
SD	69.86		
Coefficient of Variation	0.708		
Skewness	1.156		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.855	Shapiro Wilk Test Statistic	0.929
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	133.2	95% H-UCL	164.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	187.7
95% Adjusted-CLT UCL	137.2	97.5% Chebyshev (MVUE) UCL	226.2
95% Modified-t UCL	134.3	99% Chebyshev (MVUE) UCL	301.7
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.858	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	53.12		
nu star	48.31		
Approximate Chi Square Value (.05)	33.35	Nonparametric Statistics	
Adjusted Level of Significance	0.0301	95% CLT UCL	130.6
Adjusted Chi Square Value	31.59	95% Jaokknife UCL	133.2
		95% Standard Bootstrap UCL	129.1
Anderson-Darling Test Statistic	0.435	95% Bootstrap-t UCL	148.1
Anderson-Darling 5% Critical Value	0.742	95% Hall's Bootstrap UCL	166.1
Kolmogorov-Smirnov Test Statistic	0.177	95% Percentile Bootstrap UCL	130.4
Kolmogorov-Smirnov 5% Critical Value	0.239	95% BCA Bootstrap UCL	136.9

Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	183.2
		97.5% Chebyshev(Mean, Sd) UCL	219.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	291.5
95% Approximate Gamma UCL	143		
95% Adjusted Gamma UCL	150.9		
Potential UCL to Use		Use 95% Approximate Gamma UCL	143
General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		Log-transformed Statistics	
Minimum	12.1	Minimum of Log Data	2.493
Maximum	146	Maximum of Log Data	4.984
Mean	74.82	Mean of log Data	3.97
Median	94.3	SD of log Data	0.948
SD	52.82		
Coefficient of Variation	0.706		
Skewness	-0.0176		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.839	Shapiro Wilk Test Statistic	0.832
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	100.9	95% H-UCL	176.7
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	176.8
95% Adjusted-CLT UCL	98.84	97.5% Chebyshev (MVUE) UCL	219
95% Modified-t UCL	100.9	99% Chebyshev (MVUE) UCL	301.9
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.279	Data do not follow a Discernable Distribution (0.05)	
Theta Star	58.5	Nonparametric Statistics:	
nu star	33.25	95% CLT UCL	98.92
Approximate Chi Square Value (.05)	21.07	95% Jackknife UCL	100.9
Adjusted Level of Significance	0.0301	95% Standard Bootstrap UCL	98.71
Adjusted Chi Square Value	19.7	95% Bootstrap-t UCL	100.8
Anderson-Darling Test Statistic	1.025	95% Hall's Bootstrap UCL	96.59
Anderson-Darling 5% Critical Value	0.749	95% Percentile Bootstrap UCL	97.5
Kolmogorov-Smirnov Test Statistic	0.253	95% BCA Bootstrap UCL	98.78
Kolmogorov-Smirnov 5% Critical Value	0.241	95% Chebyshev(Mean, Sd) UCL	138.7
Data not Gamma Distributed at 5% Significance Level		97.5% Chebyshev(Mean, Sd) UCL	166.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	220.6
95% Approximate Gamma UCL	118.1		
95% Adjusted Gamma UCL	126.3		

Cb S

Potential UCL to Use

Use 95% Chebyshev (Mean, Sd) UCL 138.7

Cu S

General Statistics

Number of Valid Observations 13 Number of Distinct Observations 13

Raw Statistics

Minimum 31.2
Maximum 4630
Mean 856
Median 669
SD 1256
Coefficient of Variation 1.467
Skewness 2.541

Log-transformed Statistics

Minimum of Log Data 3.44
Maximum of Log Data 8.44
Mean of log Data 5.628
SD of log Data 1.758

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.673
Shapiro Wilk Critical Value 0.866

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.883
Shapiro Wilk Critical Value 0.866

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 1477

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 1691
95% Modified-t UCL 1518

Assuming Lognormal Distribution

95% H-UCL 11236

95% Chebyshev (MVUE) UCL 3464
97.5% Chebyshev (MVUE) UCL 4518
99% Chebyshev (MVUE) UCL 6589

Gamma Distribution Test

k star (bias corrected) 0.479
Theta Star 1787
nu star 12.45

Approximate Chi Square Value (.05) 5.528

Adjusted Level of Significance 0.0301
Adjusted Chi Square Value 4.885

Anderson-Darling Test Statistic 0.62

Anderson-Darling 5% Critical Value 0.786

Kolmogorov-Smirnov Test Statistic 0.224

Kolmogorov-Smirnov 5% Critical Value 0.249

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 1929
95% Adjusted Gamma UCL 2182

Potential UCL to Use

Use 95% Approximate Gamma UCL 1929

Fe S

General Statistics

Number of Valid Observations 13 Number of Distinct Observations 13

Raw Statistics

Minimum 18000
Maximum 103000
Mean 49108
Median 40300
SD 26203
Coefficient of Variation 0.534
Skewness 0.949

Log-transformed Statistics

Minimum of Log Data 9.798
Maximum of Log Data 11.54
Mean of log Data 10.67
SD of log Data 0.53

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.901
Shapiro Wilk Critical Value 0.866

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.968
Shapiro Wilk Critical Value 0.866

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 62060

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 63104
95% Modified-t UCL 62379

Assuming Lognormal Distribution

95% H-UCL 69024

95% Chebyshev (MVUE) UCL 81476
97.5% Chebyshev (MVUE) UCL 95479
99% Chebyshev (MVUE) UCL 122985

Gamma Distribution Test

k star (bias corrected) 3.173
Theta Star 15476
nu star 82.5

Approximate Chi Square Value (.05) 62.57
Adjusted Level of Significance 0.0301
Adjusted Chi Square Value 60.1

Anderson-Darling Test Statistic 0.272

Anderson-Darling 5% Critical Value 0.737

Kolmogorov-Smirnov Test Statistic 0.124

Kolmogorov-Smirnov 5% Critical Value 0.238

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 61061
95% Jaokknife UCL 62060
95% Standard Bootstrap UCL 60872
95% Bootstrap-t UCL 65688
95% Hall's Bootstrap UCL 67259
95% Percentile Bootstrap UCL 61323
95% BCA Bootstrap UCL 61538
95% Chebyshev(Mean, Sd) UCL 80785
97.5% Chebyshev(Mean, Sd) UCL 94492
99% Chebyshev(Mean, Sd) UCL 121417

Assuming Gamma Distribution

95% Approximate Gamma UCL 64751
95% Adjusted Gamma UCL 67411

Potential UCL to Use

Use 95% Student's-t UCL 62060

Mn S

General Statistics

Number of Valid Observations 13 Number of Distinct Observations 13

Raw Statistics

Log-transformed Statistics

Minimum	207	Minimum of Log Data	5.333
Maximum	2380	Maximum of Log Data	7.775
Mean	823.6	Mean of log Data	6.362
Median	504	SD of log Data	0.858
SD	740.8		
Coefficient of Variation	0.899		
Skewness	1.168		

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.788
Shapiro Wilk Critical Value	0.866

Data not Normal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	1190
95% UCLs (Adjusted for Skewness)	
95% Adjusted-CLT UCL	1233
95% Modified-t UCL	1201

Gamma Distribution Test

k star (bias corrected)	1.258
Theta Star	654.7
nu star	32.71
Approximate Chi Square Value (.05)	20.64
Adjusted Level of Significance	0.0301
Adjusted Chi Square Value	19.28
Anderson-Darling Test Statistic	0.799
Anderson-Darling 5% Critical Value	0.749
Kolmogorov-Smirnov Test Statistic	0.274
Kolmogorov-Smirnov 5% Critical Value	0.241

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	1306
95% Adjusted Gamma UCL	1397

Potential UCL to Use

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.896
Shapiro Wilk Critical Value	0.866

Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

95% H-UCL	1600
95% Chebyshev (MVUE) UCL	1699
97.5% Chebyshev (MVUE) UCL	2085
99% Chebyshev (MVUE) UCL	2842

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	1162
95% Jackknife UCL	1190
95% Standard Bootstrap UCL	1143
95% Bootstrap-t UCL	1290
95% Hall's Bootstrap UCL	1131
95% Percentile Bootstrap UCL	1148
95% BCA Bootstrap UCL	1226
95% Chebyshev(Mean, Sd) UCL	1719
97.5% Chebyshev(Mean, Sd) UCL	2107
99% Chebyshev(Mean, Sd) UCL	2868

Use 95% H-UCL **1600**

Hg S

General Statistics

Number of Valid Observations	13	Number of Distinct Observations	11
------------------------------	----	---------------------------------	----

Raw Statistics

Minimum	0.02
Maximum	0.77
Mean	0.235
Median	0.12
SD	0.254

Log-transformed Statistics

Minimum of Log Data	-3.912
Maximum of Log Data	-0.261
Mean of log Data	-1.969
SD of log Data	1.087

Coefficient of Variation 1.082

Skewness 1.471

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.75

Shapiro Wilk Critical Value 0.866

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.957

Shapiro Wilk Critical Value 0.866

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 0.36

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 0.381

95% Modified-t UCL 0.365

Assuming Lognormal Distribution

95% H-UCL 0.646

95% Chebyshev (MVUE) UCL 0.573

97.5% Chebyshev (MVUE) UCL 0.719

99% Chebyshev (MVUE) UCL 1.005

Gamma Distribution Test

k star (bias corrected) 0.897

Theta Star 0.262

nu star 23.32

Approximate Chi Square Value (.05) 13.34

Adjusted Level of Significance 0.0301

Adjusted Chi Square Value 12.27

Anderson-Darling Test Statistic 0.546

Anderson-Darling 5% Critical Value 0.756

Kolmogorov-Smirnov Test Statistic 0.211

Kolmogorov-Smirnov 5% Critical Value 0.243

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 0.41

95% Adjusted Gamma UCL 0.446

Potential UCL to Use

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 0.35

95% Jackknife UCL 0.36

95% Standard Bootstrap UCL 0.345

95% Bootstrap-t UCL 0.46

95% Hall's Bootstrap UCL 0.368

95% Percentile Bootstrap UCL 0.355

95% BCA Bootstrap UCL 0.375

95% Chebyshev(Mean, Sd) UCL 0.542

97.5% Chebyshev(Mean, Sd) UCL 0.674

99% Chebyshev(Mean, Sd) UCL 0.935

Use 95% Approximate Gamma UCL 0.41

General Statistics

Number of Valid Data 13

Number of Distinct Detected Data 5

Number of Detected Data 5

Number of Non-Detect Data 8

Percent Non-Detects 61.54%

Raw Statistics

Minimum Detected 0.16

Maximum Detected 2.5

Mean of Detected 0.828

SD of Detected 0.948

Minimum Non-Detect 1.25

Maximum Non-Detect 1.25

Log-transformed Statistics

Minimum Detected -1.833

Maximum Detected 0.916

Mean of Detected -0.616

SD of Detected 0.994

Minimum Non-Detect 0.223

Maximum Non-Detect 0.223

Th S

Warning: There are only 5 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.71
5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level	

Assuming Normal Distribution

DL/2 Substitution Method	
Mean	0.703
SD	0.557
95% DL/2 (t) UCL	0.978

Maximum Likelihood Estimate(MLE) Method N/A
MLE method failed to converge properly

Lognormal Distribution Test: with Detected Values Only

Shapiro Wilk Test Statistic	0.933
5% Shapiro Wilk Critical Value	0.762
Data appear Lognormal at 5% Significance Level	

Assuming Lognormal Distribution

DL/2 Substitution Method	
Mean	-0.526
SD	0.579
95% H-Stat (DL/2) UCL	1.612

Log ROS Method	
Mean in Log Scale	-0.844
SD in Log Scale	0.805
Mean in Original Scale	0.599
SD in Original Scale	0.622
95% Percentile Bootstrap UCL	0.903
95% BCA Bootstrap UCL	1.031

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.658
Theta Star	1.258
nu star	6.581

A-D Test Statistic	0.485
5% A-D Critical Value	0.688
K-S Test Statistic	0.688
5% K-S Critical Value	0.363

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.0983
Maximum	2.5
Mean	0.763
Median	0.56
SD	0.627
k star	1.428
Theta star	0.534
Nu star	37.14
AppChi2	24.19
95% Gamma Approximate UCL	1.171
95% Adjusted Gamma UCL	1.247

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	0.571
SD	0.578
SE of Mean	0.191
95% KM (t) UCL	0.912
95% KM (z) UCL	0.886
95% KM (jackknife) UCL	0.903
95% KM (bootstrap t) UCL	1.19
95% KM (BCA) UCL	0.928
95% KM (Percentile Bootstrap) UCL	0.869
95% KM (Chebyshev) UCL	1.405
97.5% KM (Chebyshev) UCL	1.767
99% KM (Chebyshev) UCL	2.476

Potential UCLs to Use

95% KM (t) UCL	0.912
----------------	--------------

Note: DL/2 is not a recommended method.

Vn S

General Statistics

Number of Valid Observations	13	Number of Distinct Observations	13
------------------------------	----	---------------------------------	----

Raw Statistics

Minimum	28
Maximum	80.4
Mean	42.85
Median	41.6
SD	14.25
Coefficient of Variation	0.333
Skewness	1.613

Log-transformed Statistics

Minimum of Log Data	3.332
Maximum of Log Data	4.387
Mean of log Data	3.714
SD of log Data	0.298

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.854
Shapiro Wilk Critical Value	0.866

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.938
Shapiro Wilk Critical Value	0.866

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	49.9
---------------------	------

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	51.24
95% Modified-t UCL	50.19

Assuming Lognormal Distribution

95% H-UCL	50.52
-----------	-------

95% Chebyshev (MVUE) UCL	58.26
97.5% Chebyshev (MVUE) UCL	64.98
99% Chebyshev (MVUE) UCL	78.17

Gamma Distribution Test

k star (bias corrected)	9.005
Theta Star	4.759
nu star	234.1

Approximate Chi Square Value (.05)	199.7
Adjusted Level of Significance	0.0301
Adjusted Chi Square Value	195.2

Anderson-Darling Test Statistic	0.399
---------------------------------	-------

Anderson-Darling 5% Critical Value	0.734
------------------------------------	-------

Kolmogorov-Smirnov Test Statistic	0.184
-----------------------------------	-------

Kolmogorov-Smirnov 5% Critical Value	0.237
--------------------------------------	-------

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	50.24
---------------------------	-------

95% Adjusted Gamma UCL	51.41
------------------------	-------

Potential UCL to Use

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	49.36
-------------	-------

95% Jackknife UCL	49.9
-------------------	------

95% Standard Bootstrap UCL	49.11
----------------------------	-------

95% Bootstrap-t UCL	53.45
---------------------	-------

95% Hall's Bootstrap UCL	78.39
--------------------------	-------

95% Percentile Bootstrap UCL	49.66
------------------------------	-------

95% BCA Bootstrap UCL	51.18
-----------------------	-------

95% Chebyshev(Mean, Sd) UCL	60.08
-----------------------------	-------

97.5% Chebyshev(Mean, Sd) UCL	67.54
-------------------------------	-------

99% Chebyshev(Mean, Sd) UCL	82.18
-----------------------------	-------

Use 95% Approximate Gamma UCL	50.24
-------------------------------	-------